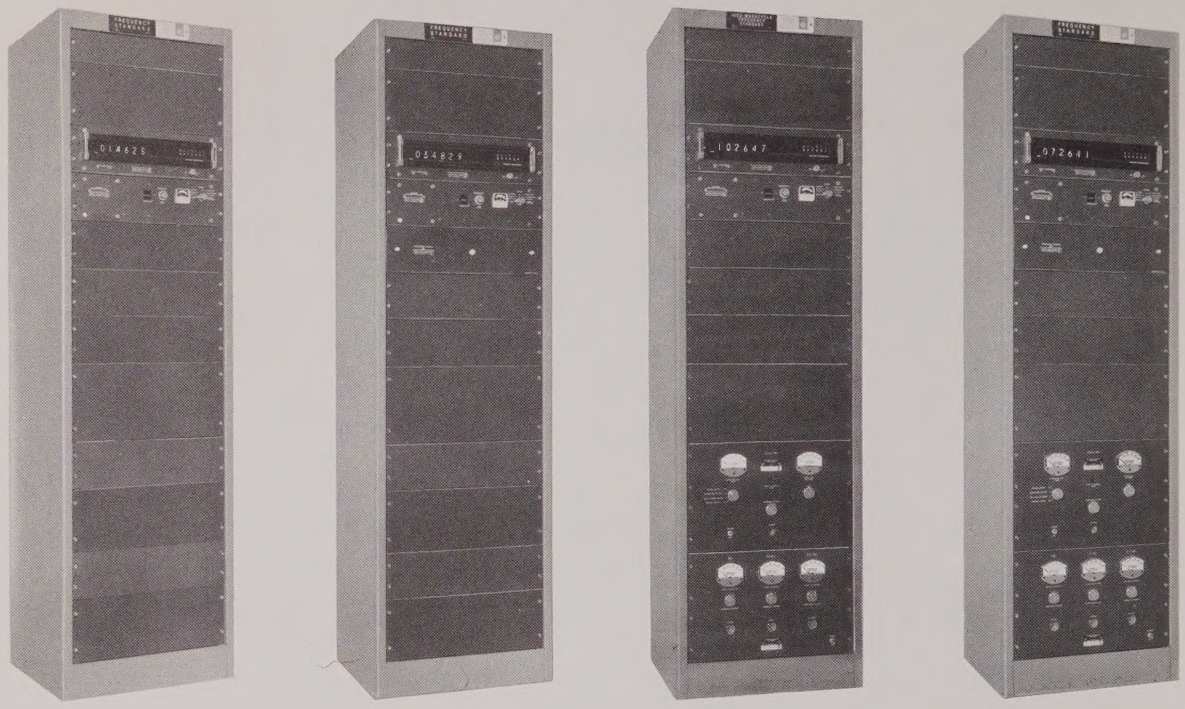
INSTRUCTION MANUAL

TYPES 1121-A,-AL,-AH,-AHL

FREQUENCY AND TIME STANDARDS

GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS 01781



SPECIFICATIONS

Catalog number information

1121-9701	1121-9831	1121-9817	1121-9553
Type **1121-A**	Type **1121-AL**	Type **1121-AH**	Type **1121-AHL**
Frequency and Time Standard		100-Mc Frequency and Time Standard	

Sine wave output

100 kc/s	60, 100, 400 c/s		60, 100, 400 c/s
100 kc/s	1, 10, 100 kc/s	100 kc/s	1, 10, 100 kc/s
1, 5 Mc/s	1, 5 Mc/s	1, 5, 10, 100, 1000 Mc/s	1, 5, 10, 100, 1000 Mc/s

Timing-pulse output 0.1, 1, 10, 100 c/s; 1, 10, 100 kc/s

Power required Power requirements for oscillator and comparator are less strigent (see instruction books).

90 to 130 or 180 to 260 V	105 to 125 or 210 to 250 V	105 to 125 or 210 to 250 V	105 to 125 or 210 to 250 V
40 to 2000 c/s	50 to 400 c/s	50 to 60 c/s	50 to 60 c/s
40 W	47 W	275 W	282 W

Weight

170 lb (78 kg) net	190 lb (87 kg) net	220 lb (102 kg) net	230 lb (106 kg) net
350 lb (161 kg) shipping	360 lb (166 kg) shipping	400 lb (184 kg) shipping	410 lb (184 kg) shipping

Instruments supplied Type 1115-B Standard-Frequency Oscillator, Type 1123-A Digital Syncronometer® time comparator, plus:

	*Type 1114-A Frequency Divider	Types 1112-A and 1112-B Standard-Frequency Multipliers	Type 1114-A Frequency Divider

Accessories supplied All of the accessories included with the individual instruments are included with the assembly (Type CAP-15-4 1½-foot power cords have been substituted for the Type CAP-22 7-foot power cords normally supplied) plus a 0480-9642 relay rack, blank panels to fill the rack, a power cord to connect the rack to the ac line, and the following:

	1 ea 0874-4199 cable, 3′	1 ea 0874-4199 cable, 3′ 1 ea 0874-4219 cable, 7′	2 ea 0874-4199 cable, 3′ 1 ea 0874-4219 cable, 7′

*The Type 1114-A includes the Types 1114-P6 400-cycle and 1114-P7 60-cycle Plug-in Units but does not include the Types 1114-P1 1-Mc or 1114-P2 100-kc Plug-in Units.

These are condensed instructions. Further details are contained in the instruction books for the individual instruments.

DESCRIPTION

These frequency standards will supply standard frequencies for both laboratory measurements and production testing; for standardizing digital counters (either as a source for routine accuracy checks or directly as a counter time base); for measuring received signals in conjunction with frequency meters and other comparison equipment; and for the measurement and standardization of time.

The Type 1121 Frequency and Time Standards are combinations of the Type 1115-B Standard-Frequency Oscillator, the Type 1123-A Digital Syncronometer time comparator and auxiliary equipment, completely assembled in floor-type relay racks with all interconnecting cables. Blank panels are included to fill unused space in the rack. Each standard is thoroughly tested as an operating system before shipment.

Internal nickel-cadmium batteries provide at least 24-hour emergency operation for the standard-frequency oscillator and the time comparator.

The Type 1115-B Standard-Frequency Oscillator operates at 5 Mc/s, uses a fifth-overtone-mode quartz crystal, and furnishes output frequencies of 5 Mc/s, 1 Mc/s, and 100 kc/s.

The Type 1123-A Digital Syncronometer time comparator integrates the oscillator frequency to produce precise time-of-day information, permits accurate comparison between the frequency standard and standard-time radio transmissions, and generates timing pulses at 100, 10, and 1 kc/s, 100, 10, 1, and 0.1 c/s.

In the Type 1121-AH model, frequencies of 10, 100, and 1000 Mc/s are produced in low-noise phase-locked-oscillator frequency-multiplier units for uhf and microwave applications. The vhf and uhf signals are essentially free from submultiple output frequencies. The spectral purity of the multiplier output frequencies is determined by the fm noise generated in the multipliers. The spectrum of the 5-Mc output of the crystal oscillator is unaffected by the presence of the multipliers.

The Type 1121-AL produces low-frequency sine waves of 10 and 1 kc/s, 400, 100, and 60 c/s, and 10-kc square waves from the Type 1114-A Frequency Divider.

The Type 1121-AHL includes all the items of the -AH and -AL models, and its output frequencies extend from 60 c/s to 100 Mc/s.

OPERATION

PRELIMINARY.

Connect the rack to a source of power (the oscillator, time comparator, and frequency divider have no power switches and will come on immediately). Turn the POWER switches of both frequency multipliers ON.

To prevent possible damage to the time comparator in the event more than one number per indicator lights up, turn the PROGRAM switch to SET, the VISUAL REGISTER switch to offending indicator and push INITIATE button until only one number is lit.

If emergency battery operation of the oscillator is desired, remove the two screws on the rear of its cabinet, slide unit out of cabinet, set internal BATTERY switch to ON, return unit to cabinet, and replace screws.

If emergency battery operation of the time comparator is desired, set its rear-mounted BATTERY POWER switch to ON.

OSCILLATOR.

Check the following meter indications:

5 MC, 1 MC, 100 KC, DC VOLTS: Should indicate within the marked sectors.

OVEN TEMP: Will indicate off scale until oven is close to operating temperature (warm-up time is 4 to 6 hours).

OVEN HEATER: Will indicate outside of OVEN HTR sector until oven temperature is stabilized (4 to 6 hours).

CHARGE-DISCHARGE: Will indicate outside of CHARGE sector for a short time after instrument is connected to ac line; then will indicate within CHARGE sector. If battery is full, only a small charge current will be indicated. If unit is operating on battery, meter will indicate in DISCH sector.

FREQUENCY ADJUSTMENT. Dial reads parts in 10^{10} per division. Total range is 2700 parts. Linearity is better than $\pm 20 \times 10^{-10}$. Settability is better than $\pm 2 \times 10^{-11}$.

10 AND 100-MC MULTIPLIER.

After a few seconds delay, panel meters will show deflections with subsequent slight drifts in the indications. After about 20 minutes, changes in meter deflection should decrease and remain constant except for slight drift as instrument warms up over several hour's time.

Adjust INCREASE OUTPUT controls for desired output (normally 42 μA on 1 MC and 10 MC meters and 30 μA on 100 Mc meter).

1000 MC MULTIPLIER.

Check the following meter indications:

900 MC MULTIPLIER: Approximately 50 μA.

900 - 1000 MC MULTIPLIER: 50 μA or less.

100 MC LIMITER: Meter indication.

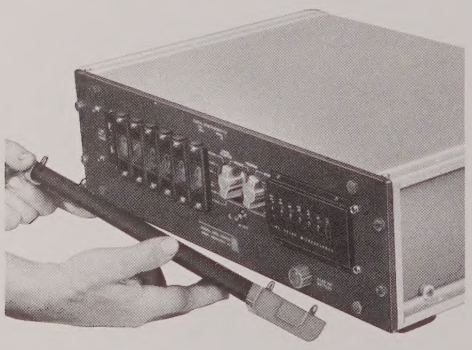
1000 MC OUTPUT: Turn INCREASE OUTPUT control clockwise; meter-current indication should increase.

KLYSTRON LOCK: To check klystron lock, turn REPELLER VOLTAGE control through its range; repeller voltage should hold constant within about 15 divisions of midscale over much of control range. Set control to SET and push PUSH TO CHECK LOCK button; repeller voltage should change slightly. If both checks are successful, klystron is locked.

TIME COMPARATOR BASIC OPERATION.

After completing any desired operation, return PROGRAM switch to OPERATE. In this position, all program functions and the INITIATE button are locked out to prevent accidental disturbance of normal operation.

For access to controls, pull off bezel.



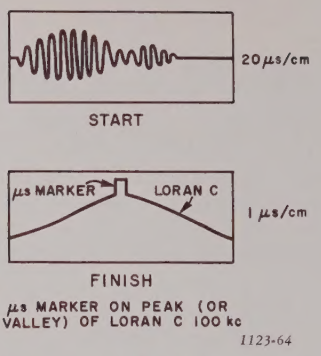
STARTING CLOCK: Turn PROGRAM switch to START and push INITIATE button.

SETTING VISUAL REGISTER: To set digits, turn PROGRAM switch to SET, turn VISUAL REGISTER switch to desired indicator, and push INITIATE button. To advance time, turn PROGRAM switch to SET, turn VISUAL REGISTER switch to OPERATE, and push INITIATE button. To hold time, turn VISUAL REGISTER switch fully clockwise.

STOPPING CLOCK: Turn PROGRAM switch to STOP and push INITIATE button.

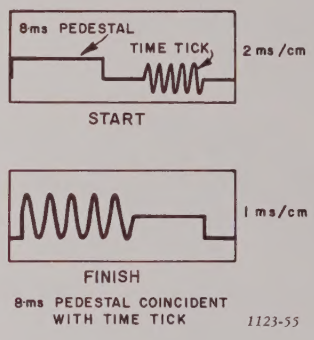
NORMAL RESOLUTION TIME COMPARISON.

Use 100, 10, and 1 ms TIME DELAY controls to move time tick to the left and 100 and 10 μs TIME DELAY controls to move 8 ms PEDESTAL to the right. Increase sweep rate to increase resolution.



When the two signals are coincident, the TIME DELAY controls indicate the amount of time the time tick is delayed from the 1 SEC TICK of the time comparator.

HIGH-RESOLUTION TIME COMPARISON.



Make measurement on third or fourth cycle of signal. Set 100 ms TIME DELAY control to X, use 10 and 1 ms and 100 and 10 μs TIME DELAY controls to move Loran C pulse to the left and use 1 and 0.1 μs TIME DELAY controls to move μs MARKER to the right. Increase sweep rate to increase resolution.

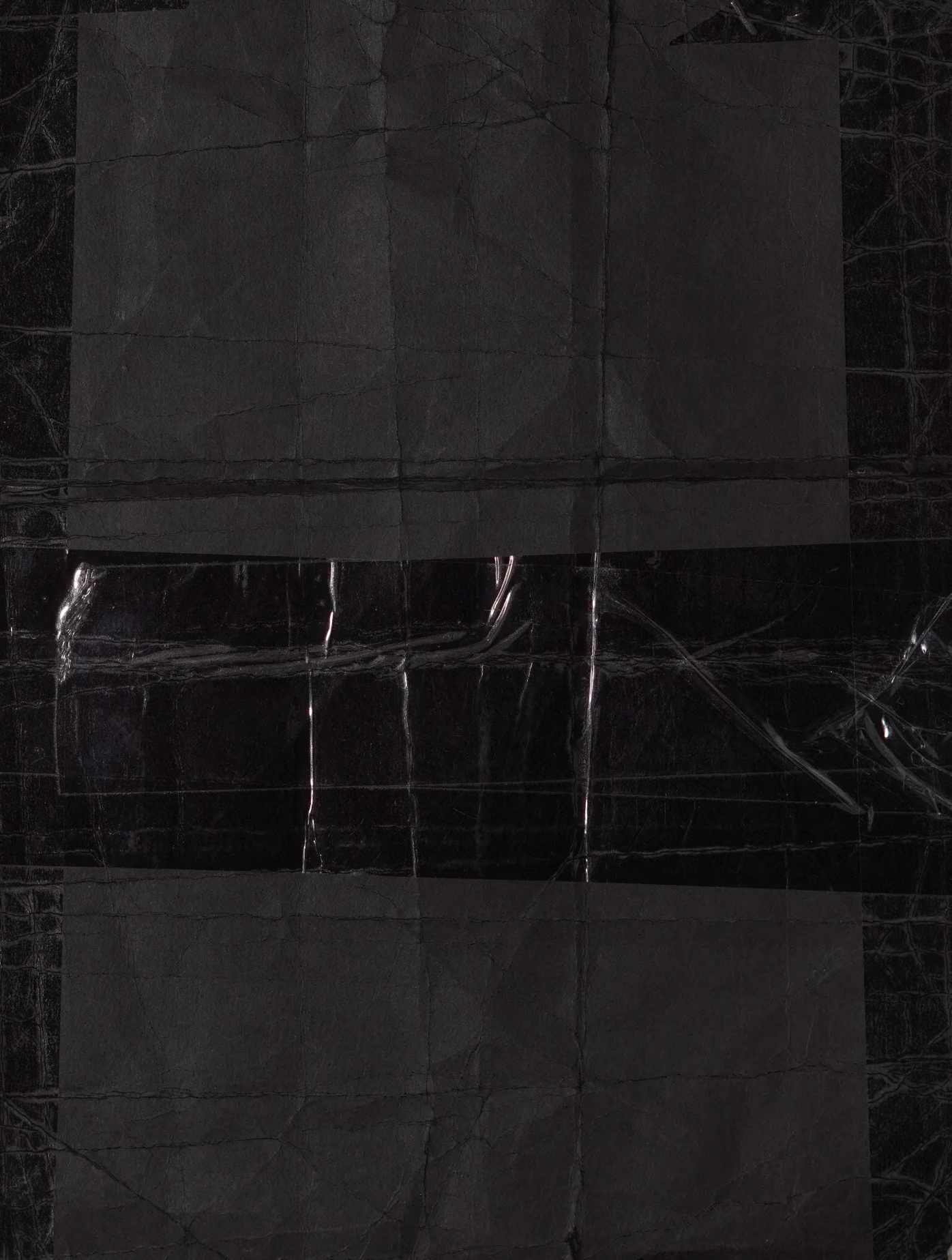
SYNCHRONIZING.

TIME-OF-ARRIVAL COINCIDENCE: Make time-comparison measurement then subtract 50 μs from TIME DELAY control setting. Set PROGRAM switch to SELF SYNC and push INITIATE button.

TIME-OF-TRANSMISSION COINCIDENCE (correction for propagation delay): Make time-comparison measurement to determine D_m (D_m = TIME DELAY control setting after time-comparison measurement). Calculate $D_m - D_T$ (D_T = propagation time between standard-time transmitter and receiver). Calculate D_S (D_S = TIME DELAY control setting corrected for propagation time):

If $D_m - D_T \geq 50$ μs, $D_S = (D_m - D_T) - 50$ μs.
If $D_m - D_T < 50$ μs, $D_S = 1,000,000 + (D_m - D_T) - 50$ μs.

Set TIME DELAY controls to D_S and push INITIATE button.



SLAVING.

If the time comparator is stopped, a signal applied to the START connector will start it regardless of the position of its PROGRAM switch. If the comparator is running, the signal will have no effect.

START TIME COMPARATORS SIMULTANEOUSLY: Zero* all comparators, turn master PROGRAM switch to START, turn slave PROGRAM switches to OPERATE, and push master INITIATE button.

SLAVE ON TIME OF ARRIVAL: Zero* slave and turn its PROGRAM switch to OPERATE. Turn master PROGRAM switch to START SLAVE, set its TIME DELAY controls to zero, and push its INITIATE button.

SLAVE ON TIME OF TRANSMISSION: Zero* slave and turn its PROGRAM switch to OPERATE. Turn master PROGRAM switch to START SLAVE, set its TIME DELAY controls to $1,000,000 - D_T$ (where D_T = cable delay in μs) and push its INITIATE button.

SLAVE AFTER TIME OF TRANSMISSION: Zero* slave and turn its PROGRAM switch to OPERATE. Turn master PROGRAM switch to START SLAVE, set its TIME DELAY controls for the desired delay, and push its INITIATE button.

ERROR DETERMINATION.

ERROR in parts in $10^{10} = \frac{\Delta t}{t}$

Error is negative if second TIME DELAY reading is less than the first and positive if second reading is greater than the first.

FREQUENCY ERROR = error X oscillator frequency

Oscillator frequency is low if error is negative and high if error is positive.

TIME ERROR in period for one second clock error = reciprocal of error.

Clock is losing time if error is negative and gaining time if error is positive.

*Turn PROGRAM switch to STOP and push INITIATE button. This stops the clock and sets the first five dividers to zero (it does not affect the visual register).

TIME	TIME IN SECONDS
1 MIN	= 6.00 x 10
2	1.20 x 10^2
3	1.80
4	2.40
5	3.00
6	3.60
7	4.20
8	4.80
9	5.40
10	6.00
11 MIN	= 6.60 x 10^2
12	7.20
13	7.80
14	8.40
15	9.00
16	9.60
17	1.02 x 10^3
18	1.08
19	1.14
20	1.20
21 MIN	= 1.26 x 10^3
22	1.32
23	1.38
24	1.44
25	1.50
26	1.56
27	1.62
28	1.68
29	1.74
30	1.80
31 MIN	= 1.86 x 10^3
32	1.92
33	1.98
34	2.04
35	2.10
36	2.16
37	2.22
38	2.28
39	2.34
40	2.40
41 MIN	= 2.46 x 10^3
42	2.52
43	2.58
44	2.64
45	2.70
46	2.76
47	2.82
48	2.88
49	2.94
50	3.00
51 MIN	= 3.06 x 10^3
52	3.12
53	3.18
54	3.24
55	3.30
56	3.36
57	3.42
58	3.48
59	3.54
60	3.60
1 HR	= 3.60 x 10^3
2	7.20
3	1.08 x 10^4
4	1.44
5	1.80
6	2.16
7	2.52
8	2.88
9	3.24
10	3.60
11 HR	= 3.96 x 10^4
12	4.32
13	4.68
14	5.04
15	5.40
16	5.76
17	6.12
18	6.48
19	6.84
20	7.20
21 HR	= 7.56 x 10^4
22	7.92
23	8.28
24	8.64
1 DAY	= 8.64 x 10^4
2	1.73 x 10^5
3	2.59
4	3.46
5	4.32
6	5.18
7	6.05
1 WK	= 6.05 x 10^5
2	1.21 x 10^6
3	1.82
4	2.42
*1 MO	= 2.42 x 10^6
*2	4.84
*3	7.26
*4	9.68
*5	1.21 x 10^7
*6	1.45
*7	1.69
*8	1.94
*9	2.18
*10	2.42
*11	2.66
*12	2.90
*13	3.15
1 YR	= 3.15 x 10^7

* 28-day (4-week) months.

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